each light beam is condensed is determined by the angle of this tilt. Therefore, the light beams having different wavelengths are condensed at different positions from one another. By forming the optical output waveguides 16 at these positions, the light beams having different wavelengths can be output from their respective optical output waveguides 16 provided for the different respective wavelengths.

For instance, as shown in Fig. 19A, light beam having undergone the wavelength division multiplexing and having wavelengths of $\lambda 1$, $\lambda 2$, $\lambda 3$, ..., λn (n is an integer equal to or larger than 2) is input to one of the optical input waveguides 12. The light beam is diffracted in the first slab waveguide 13, reach the arrayed waveguide 14, and travel through the arrayed waveguide 14 and the second slab waveguide 15. Then, as described above, the light beams are respectively condensed at different positions determined by their wavelengths, enter different optical output waveguides 16, travel along their respective optical output waveguides 16, and are output from the output ends of the respective optical output waveguides 16. The light beams having different wavelengths are output through optical fibers (not shown) connected to the output ends of the optical output waveguides 16.

In this arrayed waveguide grating type optical multiplexer/demultiplexer, an improvement in wavelength resolution of a grating is in proportion to the differences in lengths (ΔL) between the adjacent channel waveguides 14a of the arrayed waveguide 14. When the optical multiplexer/demultiplexer is designed to have a large ΔL, it is possible to multiplex/demultiplex light to accomplish wavelength division multiplexing with a narrow wavelength interval. However, in the background art there are limits to how narrow a wavelength interval can be multiplexed. The optical multiplexer/demultiplexer has a function of multiplexing/demultiplexing a plurality of signal light beams. A function of demultiplexing or multiplexing a plurality of optical signals with a wavelength interval of 1

a1 cont.

nm or less is deemed necessary for optical wavelength division multiplexing communications of high density.

Please replace the paragraph at page 5, lines 1-5, with the following text:

a2

According to this proposed arrayed waveguide grating type optical multiplexer/demultiplexer as disclosed in Japanese Patent Application Laid-open (Kokai) No. Hei 8-122557, the 3dB band width of light to be multiplexed and demultiplexed by the arrayed waveguide grating type optical multiplexer/demultiplexer can be broadened. This can be confirmed by, for example, loss wavelength characteristics shown in Fig. 22.

Please replace the paragraph at page 5, lines 12-15, with the following text:

a3

The structure shown in Fig. 23 is the structure of an arrayed waveguide grating proposed by NTT in Japanese Patent Application Laid-open (Kokai) No. Hei 9-297228. The structure shown in Fig. 24 is a structure proposed by Bell Communication Research Inc. in US Patent no. 5,629,992 titled "Passband Flattening of Integrated Optical Filters".

Please replace the paragraph at page 6, lines 2-11, with the following text:

a4

To achieve the above and other objects, the present invention is directed to an optical waveguide which may be utilized in an array waveguide grating optical multiplexer/demultiplexer. According to the present invention, the optical waveguide is a single mode waveguide and a multi-mode waveguide configured to realize multi-mode and connected to the single mode waveguide. The multi-mode waveguide is a multi-mode broadening waveguide which has a width which increases toward the direction toward the arrayed waveguide. The multi-mode broadening waveguide may have a trapezoidal shape

A4 cont. and may be connected to a constant width waveguide which has the same width as that of the upper base of a trapezoidal waveguide. Further, the multi-mode waveguide itself may include a constant width waveguide which is connected to the single mode waveguide.

Please replace the sub-paragraph at page 8, lines 12-14, with the following text:

A5 Fig. 12 is an explanatory diagram showing three-dimensionally the results of a simulation of optical amplitude distribution of light that travels along the optical input waveguide, a straight waveguide, a constant width waveguide, and a trapezoidal waveguide in the third embodiment;

Please replace the sub-paragraph at page 9, lines 15-17 , with the following text:

A6 Fig. 26 is an explanatory diagram showing three-dimensionally the results of a simulation of optical amplitude distribution of light that travels along the optical input waveguide and a parabolic tapered waveguide according to the structure shown in Fig. 23;

Please replace the paragraph at page 10, lines 6-11 , with the following text:

A7 The present inventors have experimentally manufactured five arrayed waveguide grating type optical multiplexers/demultiplexers in order to investigate characteristics of the arrayed waveguide type gratings having the slit-like waveguide 50 shown in Fig. 21. Each of these experimentally-manufactured arrayed waveguide grating type optical multiplexers/demultiplexers have the following values for the lengths W2, CW, and SW and the angle θ in Fig. 21 and for the relative refractive index difference of the arrayed waveguide type gratings.

Please replace the paragraph at page 10, lines 21-25, with the following text:

A8

According to the publication Japanese Patent Application Laid-open No. Hei 8-122557, the condition for broadening the 3dB band width is to set the ratio of the distance SW to the width W2, namely SW/W2, from 0.2 to 0.6. Therefore, the ratio of the distance SW to the width W2, SW/W2, was set so as to meet this condition in the experimentally-manufactured arrayed waveguide grating type optical multiplexer/demultiplexers.

Please replace the paragraph at page 11, lines 7-8, with the following text:

A9

In Table 1, the adjacent crosstalk is the difference between loss at the optical transmission center wavelength (hereinafter referred to as a "central wavelength") and best loss in the adjacent wavelength range of $\pm(0.8\pm0.1)$ nm of the passing band.

Please replace the paragraph at page 16, lines 11-17, with the following text:

A10

As shown in Fig. 2, the trapezoidal waveguide 5 of the present invention has a first or an upper base 4 (with a first width W3) that is wider than the width (W1) of its associated one of the optical input waveguides 12. The width of the trapezoidal waveguide 5 increases at a taper angle θ. This structure makes the trapezoidal waveguide 5 wider than its associated one of the optical input waveguides 12 along the entire length of the trapezoidal waveguide 5. A second or a lower base 6 of the trapezoidal waveguide 5 is slightly curved and the width of the trapezoidal waveguide 5 at the lower base 6 is W4 (a second width).

Please replace the paragraph at page 24, lines 17-22, with the following text:

A11

A simulation of the optical amplitude distribution of light at the output end of the trapezoidal waveguide 5 was performed on the arrayed waveguide grating type optical

multiplexer/demultiplexer of example 7 using the beam propagation method. The result of the simulation is shown in Fig. 14. This optical amplitude distribution has two peaks, and the distance c' between the peaks is large and the valley portion b' is shallow, which makes its overall shape rather flat. The base portions thereof rise sharply.

A11 cont

Please replace the paragraph at page 26, lines 17-23, with the following text:

The optical amplitude distribution in the fourth embodiment has been simulated setting the width W1 of each of the optical input waveguides 12 to 6.5 μm, the width W3 of the equal width waveguide 9 (the width of the trapezoidal waveguide 5 at the upper base 4) to 20.0 μm, the length L2 of the equal width waveguide 9 to 250 μm, the taper angle θ to 0.4°, and the width W4 of the trapezoidal waveguide 5 at the lower base 6 to 35.0 μm. The result of the simulation is shown in Fig. 16, and the optical amplitude distribution of light at the lower base 6 of the trapezoidal waveguide 5 is shown in Fig. 17.

A12

Please replace the paragraph at page 26, line 28, through page 27, line 3, with the following text:

The light transmission spectrum of the arrayed waveguide grating type optical multiplexer/demultiplexer of the fourth embodiment which has the above parameters has been measured to obtain its loss wavelength characteristics. The result is shown in Fig. 18. The front of the curve of the loss wavelength characteristics in Fig. 18 forms are very flat. As is apparent in Fig. 18, this arrayed waveguide grating type optical multiplexer/demultiplexer has very excellent characteristics in which the 1 dB band width is 0.8 nm, the adjacent crosstalk is –28 dB, and the ripple is 0.2 dB.

A13

Please replace two paragraphs at page 27, lines 8-23, with the following text:

The present invention is not limited to the above discussed embodiments, but can adopt various modifications. For instance, a trapezoidal waveguide 5 whose width increases toward the second slab waveguide 15 may be provided on the input end of the optical output waveguide 16. Alternatively, the trapezoidal waveguide 5 may be provided at both the output end of the optical input waveguide 12 and the input end of the optical output waveguide 16.

A14.

When each trapezoidal waveguide 5 is provided at each of the at least one or more optical output waveguides 16, the straight waveguide 1 as described in the first embodiment may be interposed between each optical output waveguides 16 and each trapezoidal waveguide 5. It is also possible to form the constant width waveguide 9 and the straight waveguide (narrow straight waveguide) 1 between the optical output waveguides 16 and the trapezoidal waveguide 5 as in the third and fourth embodiments.

Please replace the paragraph at page 28, line 28, through page 29, line 1, with the following text:

A15

Thus structured arrayed waveguide grating type optical multiplexer/demultiplexer of the present invention is, owing to its characteristic structure described above, capable of broadening light along the width of the trapezoidal waveguide as multi-mode distribution, improving the rising of the base portions in the optical amplitude distribution as the light travels toward the arrayed waveguide (toward the first slab guide), and increasing the distance between peaks in the optical amplitude distribution.

Please replace the paragraph at page 29, line 22, through page 30, line 3, with the following text:

The arrayed waveguide grating type optical multiplexer/demultiplexer of the present invention is capable of making the overall intensity distribution shape of light that is output from the trapezoidal waveguide free from deformation. This is achieved by providing a straight waveguide narrower than the optical input waveguides between the optical input waveguide and the trapezoidal waveguide. Alternatively, this is achieved by providing, in the structure in which the constant width waveguide is formed, a narrow straight waveguide between the constant width waveguide and its associated one of the optical input waveguides. Because of this straight waveguide or the constant straight guide, if each of the optical input waveguides has a curved portion and the central position of the light intensity distribution deviates from the center in width of the optical input waveguide after the light has traveled through this carved portion, the central position of the light intensity distribution can be moved to the center of the straight waveguide while the light travels along the straight waveguide. The light intensity center thus can be input in the center in width of the trapezoidal waveguide.

a16

Please replace the paragraph at page 30, lines 13-21, with the following text:

The optical waveguide circuit according to the embodiments of the present invention includes a single mode waveguide, and a multi-mode waveguide which has a multi mode broadening waveguide whose width increases toward a direction of the light traveling forward and which is connected to the single mode waveguide. Therefore, it is possible to improve, as the light travels, the rising of the base portions of the optical amplitude distribution of light that is output from the single mode waveguide, and to increase the distance between the peaks of the optical amplitude distribution. Applying this structure to various circuit structure such

a17